

REMARKS

This paper is submitted in response to the Final Office Action mailed August 18, 2010. A Petition for a three (3) month extension of time is filed herewith. Therefore, the time period for response extends up to and includes February 18, 2011.

Claims 1–17 and 20–34 are currently pending, with claims 18–19 previously cancelled without prejudice. No amendments have been made to the claims in the present response. The claims therefore correspond to the claims in the response filed June 29, 2010. The Listing of Claims is included in the present response merely for the Examiner's convenience.

Applicants submit the claims are in condition for allowance, and present the following remarks in support thereof.

Rejections under 35 U.S.C. § 103

In the present Office Action, the claims have been rejected under 35 U.S.C. § 103(a) as being unpatentable in view of the combinations of references discussed below. As articulated by the Supreme Court, a combination is obvious if it is no more than the predictable use of known elements according to their established functions; and there is a reason to combine the known elements. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007). To make a *prima facie* case of obviousness, “it remains necessary to identify the reason why a person of ordinary skill in the art would have combined the prior art elements in the manner claimed.” *Id.* A “reasonable expectation of success” is the standard with which obviousness is determined. MPEP § 2141; *Hodosh v. Block Drug Co.*, 786 F.2d 182, 187 n.5 (Fed. Cir. 1986). Therefore, an understanding of the general principles of solvent extraction processes is necessary in order to determine whether the combinations of references cited in the Office Action satisfy the “reasonable expectation of success” standard.

Solvent extraction is a process that uses solvent extraction reagents to selectively extract target ions into one phase, while leaving another group of ions, such as impurity ions in the other phase. This allows separation of the target ions from the impurity ions. The process typically involves bringing the identified solvent extraction system into contact with an aqueous solution

containing dissolved ions. This aqueous solution generally comes from acid leaching of a mineral ore, and valuable target metal ions may be recovered from the leach solution. Because ions other than the target valuable metal ions are present in the leach solution, the solvent extraction system must be able to selectively separate the ions so as to produce a solution which is enriched in the target metal ion or ions and contains relatively low levels of impurities.

Typically, the target metal ions are extracted into the organic phase, and the impurity ions are retained in the aqueous phase. When the organic phase and aqueous phase are separated, the target metal ions are recovered from the organic phase. Therefore, the solvent extraction reagents used in the solvent extraction process must allow the ions and impurities to be selectively partitioned between the organic and aqueous phases such that the organic phase is enriched in the target metal ions, while remaining relatively free of impurities.

When developing new solvent extraction systems, there are a number of general principles that need to be taken into account by researchers in the field. These principles are discussed in the MEAB articles on solvent extraction principles and solvent extraction research (copies enclosed).

Firstly, the researchers need to identify an extractant, or a combination of extractants, that are capable of causing only those target ions to be dissolved into the organic solution, with any impurity ions remaining in the aqueous solution. Different metal ions will distribute themselves in different ways between the organic and aqueous phases. The relative tendency of one metal species to report to either the organic or aqueous phase is not an "all or nothing" proposition - the metal ions can be partly in one phase, and partly in the other phase (as shown in Figure 2 of the MEAB article entitled "Solvent Extraction Research"). Thus, the "development and optimisation of a solvent extraction process involves considerable experimental effort in determining the most suitable conditions" (see the paragraph just above Figure 3 in the MEAB article entitled "Solvent Extraction Research").

The extent to which the metal ion will be partitioned into the organic phase will be dependent on the following factors:

- the identity of the solvent extraction system;
- the pH conditions;

- the metal ion concentration;
- the salt concentration;
- the reagent concentration;
- the time (this is related to the kinetics); and
- the temperature.

Several of these factors (pH conditions and the identity of the solvent extraction system) are discussed in more detail below

pH conditions

In solvent extraction processes, it is important that at the actual pH used in the process a high percentage of the target element present in the leach solution will be extracted into the organic phase with minimal amount of the impurity ions being extracted into the organic phase. The result is that most of the target metal ions will be in the organic phase and most of the impurity ions will be in the aqueous phase.

One of the tools used by researchers in this field to compare the tendency of one metal ion to report to the organic or aqueous phase compared to another metal is the pH at which 50% extraction would take place (pH 0.5, or pH_{50}). By comparing the pH_{50} for different metals in a solvent extraction system, it is possible to determine whether there is a pH at which a solvent extraction system can be operated so as to extract enough of the target element into the organic phase while the impurity element remains in the aqueous phase. A sufficient difference in the pH_{50} value for base metals (nickel, cobalt, zinc, manganese, copper, etc.) is required to achieve a commercially viable separation of the target elements from rejected or impurity elements. It is generally accepted in this technology field that the difference between the pH_{50} values of the target metal ions to be extracted into the organic phase and the impurity ions which are to remain in the aqueous phase should be at least 1.0 pH unit for a reasonable separation, or 1.5 pH units for a good separation, or >2.0 pH units for excellent separation as far as base metals are concerned. This means that the solvent extraction process can proceed at a pH between the pH_{50} for the target and impurity ions, which will result in most of the target element being extracted into the organic phase and most of the impurity element remaining in the aqueous phase.

If the pH₅₀ values of two metal ions which are to be separated from each other are similar values (i.e. the difference between the two pH₅₀ values is less than 1.0 pH unit for base metals) then the solvent extraction system is not capable of separating those ions to the degree required for a commercial separation. Under such conditions, the solvent extraction system will be unable to extract the target element into the organic phase and retain the impurity element in the aqueous phase in sufficiently high concentrations to effect an acceptable separation.

Identity of solvent extraction system

Another factor which impacts on determining how a metal ion will be partitioned into the organic phase is the identity of the solvent extraction system. It is known in the solvent extraction art that changing the identity of the extractant greatly changes the pH₅₀ for each element. Accordingly, it is not possible to change between extractants without significantly changing the pH₅₀ for each metal species.

It is generally accepted in the art that information specific to one extractant and its behaviour is not relevant to a different extractant. Because of this lack of predictability, one of skill in the art would not generally combine such teachings as there is no reasonable expectation of achieving a successful separation.

Moreover, the addition of additives to a solvent extraction system can change the pH₅₀ values of the target and impurity ions and the way in which the metal ions are partitioned between the organic and aqueous phases. The partition of the metal ions between the organic and aqueous phases is completely changed by the addition of additives to the solvent extraction system and the effect of such additives on the partition of the metal ions between the phases is unpredictable.

Within the context of these general principles of solvent extraction processes, the following obviousness rejections are addressed:

(1) Claims 1-15, 17, 22-26, and 28-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Davis (US 4,104,359) in view of Cheng (WO 02/22896). Applicants respectfully traverse this rejection.

Claim 1, from which claims 2–15, 17, 22-26, 28-29 and 34 depend, recites a process for the separation of cobalt and/or manganese from impurities (i.e., calcium or magnesium) in a leach solution. The process includes the step of subjecting the leach solution to solvent extraction using an organic solution of a carboxylic acid, 2-methyl-2-ethyl heptanoic acid, or a cationic exchange extractant with extraction characteristics similar to 2-methyl-2-ethyl heptanoic acid, along with a chelating α -hydroxyoxime. Claim 30, from which claims 31–33 depend, recites a process for the separation of zinc, copper and cobalt from impurities (i.e., manganese, calcium and magnesium) in a leach solution. The process includes the step of subjecting the leach solution to solvent extraction using an organic solution of a carboxylic acid, 2-methyl-2-ethyl heptanoic acid, or a cationic exchange extractant with extraction characteristics similar to 2-methyl-2-ethyl heptanoic acid, along with a chelating α -hydroxyoxime.

The Office Action alleges that Davis discloses the separation of nickel and cobalt in an acid leach where hydroxylamine sulfate (anti-oxidant) is added to the organic solution of an oxime, sulfonic acid and kerosene. This is described in Example 2 of Davis, where the separation is performed using dinonylnaphthalene sulfonic acid. However, independent claims 1 and 30 refer to an extractant that is an organic solution of a chelating aliphatic α -hydroxyoxime and a carboxylic acid which is 2-methyl 2-ethyl heptanoic acid or a cationic exchange extractant having extraction characteristics similar to 2-methyl 2-ethyl heptanoic acid. The disclosure in Davis therefore refers to a different extraction system.

As described above, the identity of the solvent extraction system impacts on how a metal ion will be partitioned between the organic and aqueous phases. For example, changing the identity of the extractant was known to greatly change the pH₅₀ for each element. It therefore was generally accepted in the art at the time of filing of the present application that information specific to one extractant and its behaviour is not relevant to a different extractant. Because of this lack of predictability, a person of skill in the art would have recognized that a sulfonic acid extractant (as per Davis) behaves very differently compared to the claimed 2-methyl 2-ethyl

heptanoic acid extractant (a carboxylic acid extractant) in terms of its impact on the relative tendency of ions, such as cobalt and/or manganese, to be extracted into the organic phase (as represented by the pH₅₀ value), and that it is not possible to change between extractants without significant differences in the pH₅₀ for each metal species, which would lead to different outcomes in the separation process. Accordingly, one of skill in the art would not have reasonably expected the extractants in Davis to behave similarly to the extractants in the claimed solvent extraction process.

Applicants also note that Davis is inapplicable to the present claims as it teaches the use of the hydroxylamine sulphate in a separate regeneration step. The hydroxylamine sulphate is therefore not present in the organic extraction solution when it contacts the leach solution during the solvent extraction process (see Davis, for example, at col. 5, lines 35-52). Davis therefore relates to a completely different process and fails to disclose or suggest all the elements of the claims.

The Office Action alleges it would have been obvious to combine Cheng with Davis because Cheng teaches that the carboxylic acid and synergist, such as an oxime, is beneficial for separating nickel and cobalt from manganese and calcium. Applicants do not agree and submit the secondary Cheng reference does not cure the deficiencies of the primary Davis reference.

First, Cheng does not achieve separation with a carboxylic acid and an oxime, and teaches away from the single-stage reaction recited in the claims. Cheng discloses that the carboxylic acid and oxime must be used with two additional rounds of extractions to achieve a suitable separation. The process in Cheng is a 3-stage extraction process in which three different extractant systems are used sequentially in three circuits to separate and recover the nickel and cobalt. Cheng does not disclose or suggest that the extraction could be performed using the one extractant as defined in the claims of the present invention. Absent Applicants' disclosure, one of skill in the art would not have been motivated to combine Cheng with Davis as alleged in the Office Action as Cheng teaches away from a single-stage reaction.

Secondly, Cheng does not disclose or suggest the claimed agents. In particular, Cheng does not disclose or suggest a combination of 2-methyl, 2-ethyl heptanoic acid and an aliphatic α -hydroxyoxime. Cheng only refers to the use of carboxylic acid and a synergist. A non-

chelating oxime is listed as one example of the synergist. In contrast, the claims require a chelating oxime which is different from and the opposite of the non-chelating oxime disclosed in Cheng. Cheng also does not disclose use of the non-chelating synergist in the process. Instead, Cheng discloses a preference for another type of synergist which is not an oxime and does not display the same properties as the claimed chelating oxime.

In relation to the carboxylic acid, the Office Action asserts that Cheng discloses the use of any carboxylic acid in the extraction process. The Office Action asserts it would have been obvious to a person skilled in the art to use 2-methyl, 2-ethyl heptanoic acid, because Cheng teaches the application of the broad number of different carboxylic acid to be used in similar extraction processes. Applicants do not agree.

Cheng does not disclose or suggest selecting 2-methyl, 2-ethyl heptanoic acid from among “any carboxylic acid” and combining this particular carboxylic acid with a particular synergist, such as a chelating aliphatic α -hydroxyoxime, for use in a single-stage extraction in place of the 3-stage extraction described in Cheng. Applicants disclose that through the use of this particular combination (2-methyl, 2-ethyl heptanoic acid and a chelating aliphatic α -hydroxyoxime) that the separation can be achieved in one stage, and not three. Therefore, absent Applicants’ disclosure, one of skill in the art would not have been motivated to combine Cheng and Davis as alleged in the Office Action and would not have had a reasonable expectation of successfully arriving at claim 1 or claim 30.

As discussed above in the section regarding general principles of solvent extraction processes, it is not a simple matter for one of skill in the art to combine the disclosures of Davis and Cheng by merely selecting some components disclosed in Davis and combining these with other components selected from Cheng. The effect of different extractants and additives in a given solvent extraction system is unpredictable with respect to pH₅₀ and the way in which the target and impurity elements are partitioned between the organic and aqueous phases. Because of this lack of predictability, one of skill in the art would not have been motivated to combine Davis and Cheng as alleged in the Office Action because there would have been no reasonable expectation of achieving a successful separation.

Claims 2–15, 17, 22–26, 28–29 and 34 depend directly or indirectly from claim 1 and incorporate all the limitations thereof. Claims 31–33 depend from independent claim 30 and similarly incorporate all the limitations thereof. Therefore, these claims are not *prima facie* obvious over the combination of Davis and Cheng for substantially the same reasons as indicated above for claims 1 and 30.

In view of the foregoing, Applicants submit the combination of Davis and Cheng fails to establish a *prima facie* case of obviousness. Withdrawal of the rejection is respectfully requested.

(2) Claims 14–16 and 20–21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Davis in view of Cheng and further in view of Mihaylov (US 5,447,552). Applicants respectfully traverse this rejection.

Claims 14–16 and 20–21 depend from claim 1 and therefore incorporate all the limitations thereof. The combination of Davis and Cheng does not render claim 1 unpatentable for the reasons discussed above. The discussion of Davis and Cheng as applied to claim 1 above is fully incorporated herein to avoid duplication.

The deficiencies of the combination of Davis and Cheng is not cured by Mihaylov. The Mihaylov reference discloses a process for recovery and separation of nickel and cobalt from an acid leaching solution at a pH of 2 to 6 using a dithiophosphinic acid. However, there is no teaching or suggestion in Mihaylov of combining a carboxylic acid extractant with a chelating oxime to arrive at the process as in the present claims.

Moreover, Mihaylov teaches away from the use of oximes in the disclosed process, noting the tendency of non-chelating oximes to hydrolyze and the kinetic and stripping problems associated with using chelating oximes in extraction. Mihaylov states that “once loaded into these chelating oximes, cobalt (II) tends to oxidize to cobalt (III), which adversely affects stripping and may degrade the oxime reagent” (*see* Mihaylov, at col. 2, ll. 23–26). Mihaylov also notes that the rate for nickel extraction using chelating hydroxyoximes is very slow (*see* Mihaylov, at col. 2, ll. 26–28). Mihaylov does not disclose or suggest how to overcome slow extraction and/or stripping kinetics with nickel when using a carboxylic acid extractant and a

chelating oxime. Mihaylov, therefore, disparages the use of chelating oximes in a process to extract cobalt and nickel.

Applicants further submit that the process recited in the present claims shows unexpected and surprising advantages over the methods described in the cited references. As discussed in the response filed June 29, 2010, the results of tests described in the paper by the inventor entitled "Solvent extraction of nickel and cobalt with synergistic systems consisting of carboxylic acid and aliphatic hydroxyoxime," *Hydrometallurgy*, 84 (2006): 109–117 show that the synergistic solvent extraction process embodied in the present claims gives excellent results that are not predictable from the combination of references cited in the Office Action. For example, as shown in Figure 6, the extraction kinetics of cobalt separation are excellent, with all the cobalt extracted within 30 seconds. Similarly, as shown in Figure 7 of the paper, stripping of cobalt is also very fast, such that within two minutes, over 95% of the cobalt has been stripped. These results are not predictable from the disclosures in the cited references (alone or in combination).

Therefore, Mihaylov does not cure the deficiencies of the combination of Davis and Cheng. Accordingly, claims 14-16 and 20-21 are not *prima facie* obvious, and the rejection over Davis, Cheng, and Mihaylov under 35 U.S.C. § 103 should be withdrawn.

In view of the foregoing, reconsideration and withdrawal of the rejection is respectfully requested.

(3) Claim 27 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Davis in view of Cheng and further in view of Dreisinger (WO 98/14623). Applicants respectfully traverse this rejection.

Claim 27 depends from claim 1 and therefore incorporates all the limitations thereof. The combination of Davis and Cheng does not render claim 1 unpatentable for the reasons discussed above. The discussion of Davis and Cheng as applied to claim 1 above is fully incorporated herein to avoid duplication.

The deficiencies of the combination of Davis and Cheng are not cured by Dreisinger. The reference describes a method for extracting copper, cobalt and zinc from an ore that also

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includes manganese dioxide. The method describes direct leaching in saline of the ore followed by extraction of the metal by solvent extraction methods followed by electrowinning or precipitation (*see Dreisinger, at p. 1, ll. 10–15*). However, there is no teaching or suggestion in Dreisinger of combining a carboxylic acid extractant with a chelating oxime to arrive at the process as recited in claim 1. Therefore, Dreisinger does not disclose all the elements of claim 1. Since claim 27 depends from claim 1, Dreisinger also does not disclose all the elements of claim 27, whether taken alone or in combination with Davis and Cheng.

In view of the foregoing, reconsideration and withdrawal of the rejection is respectfully requested.

Summary

In view of the above amendments and remarks, Applicants respectfully request a Notice of Allowance. Applicants do not otherwise concede the correctness of the Examiner's rejections and reserves the right to make additional arguments as may be necessary. If the Examiner believes a telephone conference would advance the prosecution of this application, the Examiner is invited to telephone the undersigned at the below-listed telephone number.

Please consider this a PETITION FOR EXTENSION OF TIME for a sufficient number of months to enter these papers or any future reply, if appropriate. Please charge any additional fees or credit overpayment to Deposit Account No. 13-2725.

Respectfully submitted,

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